Governor's Water Augmentation, Innovation, and Conservation Council

Long-Term Water Augmentation Committee

January 13, 2022

Agenda

I. Welcome – *Wade Noble, Committee Chair*

II. Weather Modification and Cloud Control

   a. Overview of State Statutes – *Jennifer Heim, ADWR Deputy Counsel and Catherine Riedel, ADWR Community Water Systems Coordinator*

   b. Overview of Research Efforts and Active Projects – *James Walter, SRP Water Measurement Lead/Meteorologist*

III. Development of Long-Term Water Augmentation Plan – *Wade Noble, Committee Chair*

IV. Next Steps

V. Adjournment

Webinar Logistics

- **Indicate you wish to speak by typing your name in the chat box, and you will be invited to unmute and speak. Please message "Everyone" in the chat.**
- **Please state your name when speaking.**
- **Mute yourself when not speaking.**
- **If you have a written comment, please message "Everyone" in the chat.**
- **The meeting and chat will be recorded.**

Technical issues? Send a ***'chat message' to ADWR-Host*** *in the chat, call the ADWR Help Desk at* ***602-771-8444*** *or send an email to* ***tickets@azwater.gov****.*

I. Welcome

Wade Noble, Committee Chair

II. Weather Modification and Cloud Control
a. Overview of State Statutes

Jennifer Heim, ADWR Deputy Counsel
Catherine Riedel, ADWR Community Water Systems Coordinator

Existing Statutes

Arizona's weather modification statutes were first enacted in the 1950s and have remained relatively unchanged since that time.

They require a person, other than the US or the state, to apply for and obtain a license from ADWR before conducting any weather control or cloud modification operations or attempting artificially to produce rainfall.

Existing Statutes

Under existing statutes, applicants are required to provide:

- Information identifying operating personnel, including information about individuals connected with the operating organization.
- Scientific qualifications of all operating or supervising personnel.
- Information about all other completed or existing contracts at the time the application is made.
- Description of the methods of operation and a description of the aircraft, ground and meteorological services to be utilized.
- Names of the contracting parties within the state, including the area to be served, the months of operation, and the dates when evaluations will be submitted.

Existing Statutes

- Licensees are required to file evaluation reports every 6 months during the operation of a project and a final evaluation 90 days after the conclusion of the project.
- Conducting unlicensed weather modification operations is considered a class 3 misdemeanor.
- Exception from licensing requirement for use and operation of equipment and supplies designed for weather modification by owner, lessee, or licensee of real property used for agricultural purposes on the property for his exclusive benefit.

Unanswered Questions

These statutes contain gaps that give rise to questions:

1. What are acceptable or unacceptable objectives related to weather modification?
2. What showings of technical feasibility and/or efficacy should be required?
3. How should issues related to potential liability for bad outcomes be addressed?

Benefits of Certainty

- Other states have addressed these questions in different ways.
- In Arizona, the regulated community and the state would benefit from having greater certainty with respect to these issues.
- Increased certainty may encourage beneficial projects to go forward that would otherwise not occur, while still providing appropriate protections to the public.

State Overview

IV. APPENDIX A[261]

States	Reporting	License & Permit	Public Participiation	Liability
Alaska*[262]				
Arizona[263]	X	X		
Arkansas*[264]				
California[265]	X			
Colorado[266]	X	X	X	X
Florida[267]	X	X	X	
Idaho[268]	X		X	
Illinois[269]			X	
Kansas[270]	X	X	X	X
Louisiana[271]	X	X		
Maryland[272]	X	X		
Montana[273]	X	X	X	X
Nebraska*[274]				
Nevada[275]	X	X	X	
New Hampshire*[276]				
New Mexico[277]	X	X	X	X
North Dakota[278]	X	X	X	X
Oklahoma[279]	X	X	X	X
Oregon[280]	X	X	X	
Pennsylvania[281]	X	X	X	X
Rhode Island*[282]				
Tennessee*[283]				
Texas[284]	X	X	X	X
Utah[285]	X	X	X	X
Virginia*[286]				
Washington[287]	X	X	X	X
West Virginia*[288]				
Wisconsin[289]	X	X	X	X
Wyoming[290]	X	X		X
Washington, D.C.*[291]				
30		**18**	**16**	**12**

*Have laws which only reference weather modification in passing.

Hertz, M. L. (2021). It's Raining, It's Pouring, Weather Modification Regulation Is Snoring: A Proposal to Fill the Gap in Weather Modification Governance. NDL Rev., 96, 31.

New Mexico

Agency	New Mexico Interstate Stream Commission.
Permitting & Licensing	**Licensing:** Any person desiring to engage in operations shall be required to make application for and receive a license. The applicant must demonstrates qualifications for conducting operations, (ex: possess a Bachelor's degree in Meteorology with 2 years experience or a Master's Degree in Meteorology or related field). Each license shall expire twelve (12) months after the issuance date. Can be renewed.
Reporting	Tri-monthly reports, summary reports on observed results of each operation, reports to sponsors, and Federal reporting in which the operator is responsible for complying with all applicable federal reporting requirements including reporting to the national oceanic and atmospheric administration must be submitted
Liability	**State Liability:** General statute stating no liability or responsibility can be imposed on the state, its agencies, employees, or weather modification authorities **Applicant Liability:** n/a
Misc.	Weather Control Committee shall consider the merits of an application and otherwise determine if the requirements of the Weather Control Act and this rule have been met and may hold a hearing on such application at its discretion

Utah

Agency	Utah Division of Water Resources
Permitting & Licensing	**Licensing:** Shall be issued to applicants who meet the requirements. Requirements include proof of professional experience, Bachelor's Degree or higher degree in in meteorology or related physical science or engineering and at least five years experience in the field of meteorology, or sufficient training/experience in cloud seeding. Each license shall be issued for one year and can be renewed. **Permitting:** Each permit shall be issued for a period as required by a proposed cloud seeding project, but not exceeding one year. Must submit proof of financial responsibility, copy of contract or proposed contract between the sponsor and licensed contractor relating to the project, plan of operation for the project,
Reporting	Submit copies of the daily log and supplemental information for each month to the Division.
Liability	**State Liability:** General statute stating no liability or responsibility can be imposed on the state, its agencies, employees, or weather modification authorities **Applicant Liability:** n/a
Misc.	State has a Weather Modification Advisory Committee that advise the Director and technical staff of the Division on applications for licenses & permits and make recommendations concerning legislation, policies, administration, research, and other matters related to cloud seeding and weather modification activities to the Director and technical staff of the Division.

Wyoming

Agency	The Wyoming Water Development Office (WWDO)
Permitting & Licensing	**Permitting:** A separate permit shall be issued for each experiment or activity. Permits are revocable by the state engineer. Permits are to be issued for one year. A permit shall be issued only to a person who can demonstrate to the state engineer's satisfaction that he has adequate qualifications in the atmospheric sciences. The state engineer shall promulgate rules and regulations necessary to implement this act.
Reporting	Monthly reports should be made to the Wyoming State Engineer's Office. As a courtesy, the reports should be copied to the Forest Service, BLM, and the Tribes as well. Project reports must be filed prior to the beginning of each operational season and must include description of the area(s) to be targeted, the starting and proposed ending dates and a description of the seeding agents to be used. At the conclusion of the project, a report describing the dates of all seeding activities and the amounts and types of each seeding agent dispersed on each day must be provided, as well as monthly totals.
Liability	**State Liability:** General statute stating no liability or responsibility can be imposed on the state, its agencies, employees, or weather modification authorities **Applicant Liability:** n/a
Misc.	The state engineer is authorized to receive in the name of the state any funds offered or available from any source, and to expend such funds for the expenses of administering this act and for the encouragement of experimentation in weather modification.

Colorado

Agency	Colorado Water Conservation Board (CWCB), Department of Natural Resources
Permitting & Licensing	**Licensing:** Requires either four years experience, a physical sciences or engineering degree, a certification from the Weather Modification Association, or other relevant experience and training as approved by the Director **Permitting:** Requires licensed operator, operational plan, proof of financial responsibility, public participation, and safeguards. Permits for ground-based operations last for 5 years, all other permits last 1 year
Reporting	Daily logs and annual reports are required for all weather modification operations. Aircraft-based operations require additional record-keeping.
Liability	**State Liability:** Governmental immunity clause **Applicant Liability:** State limits which types of liability pertain to weather modification, which do not, and defines legal recourse for operators who fail to meet the regulations
Misc.	Requires all projects meet the standards outlined by the American Society of Civil Engineers

Texas

Agency	Department of Licensing and Regulation
Permitting & Licensing	**Licensing:** State must deem the applicant is reasonably competent in the field of meteorology. Licenses expire at the end of fiscal year in which they were issued **Permitting:** Requires a valid license, permit fee, notice of intent, proof of publication, and proof of financial responsibility
Reporting	Record of each operation including method employed, type of equipment, kind and amount of material used, times and places equipment was operated, and name and mailing address of each individual
Liability	**State Liability:** Provides state immunity **Applicant Liability:** State limits which types of liability pertain to weather modification, which do not, and outlines what is not admissible as defense
Misc.	Statute requires continuous research on behalf of the state

North Dakota

Agency	Department of Water Resources - Atmospheric Resources Board
Permitting & Licensing	**Licensing:** Contains minimum experience and education requirements. May consider professional organizations, references, publications, and previous weather modification permits, if applicable. **Permitting:** Requires proof of financial responsibility, a complete operational plan, a license, application fee, any pertinent bond or insurance information, and copies of all advertising materials
Reporting	Report consists of a daily log of modification activities, monthly totals, exempted weather modification activities, addresses of participants, inspections, a copy of the federal report, and a final narrative on the results
Liability	**State Liability:** General statute stating no liability or responsibility can be imposed on the state, its agencies, employees, or weather modification authorities **Applicant Liability:** State limits which types of liability pertain to weather modification, which do not, and outlines what is not admissible as defense
Misc.	Requires a licensed weather modification operator to be on-site at all times modification activities are actively occurring

Overview of Research Efforts and Active Projects

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James Walter
SRP Water Resources

January 13, 2022

Outline

- Breakthroughs in Science

- Winter Cloud Seeding Activities in the West

- White Mountains Research Project

Breakthroughs in Science

Source: North American Weather Modification Council

1) Air is forced up and over mountains and cools

2) Moisture condenses and forms a cloud with cloud drops remaining liquid even in sub freezing temperatures (super cooled liquid water – SLW)

3) Ice and dust particles act as nuclei for SLW and freeze.

4) Additional SLW freeze onto the ice forming a snowflake

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Breakthroughs in Science

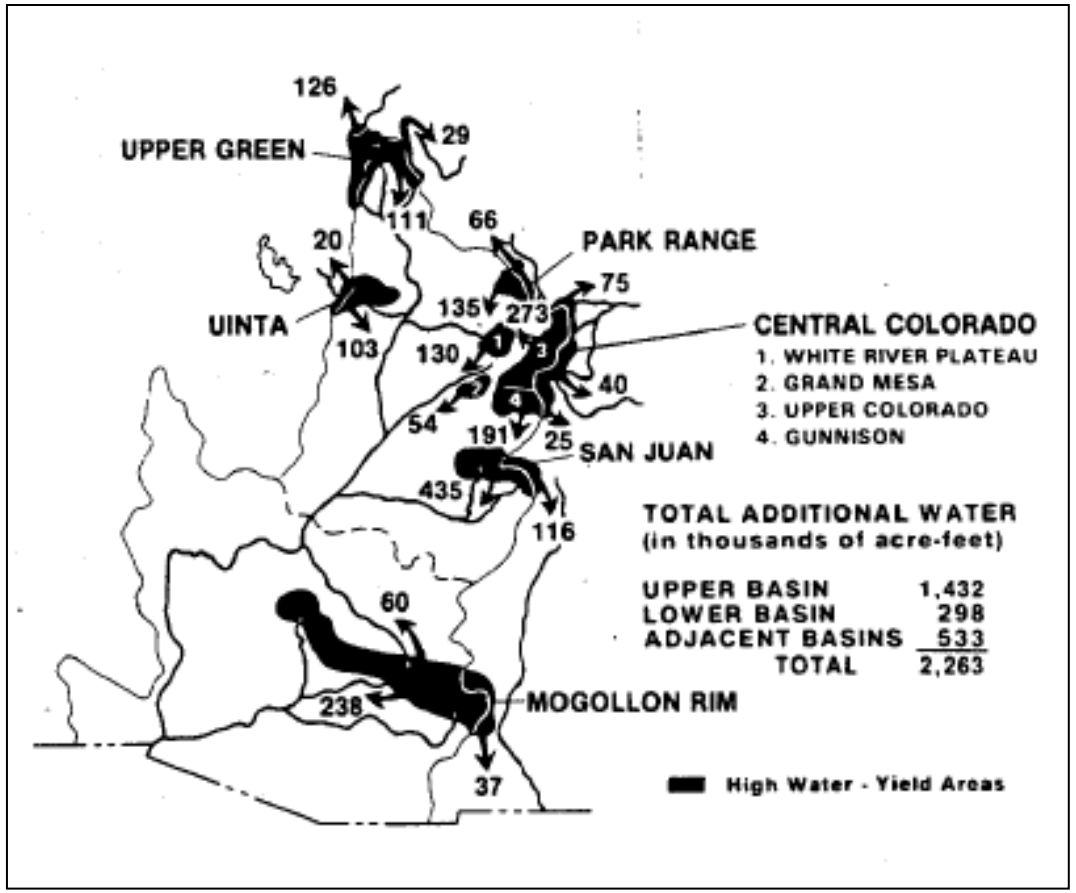
Early Research and Activities

1946 – GE Scientist serendipitously discover cloud seeding

1947 – Phoenix College/AZ Republic start seeding clouds

1950’s-60’s – SRP seeds clouds over Salt and Verde Watershed, UoA cloud seeding research over southern AZ, military research cloud seeding in Flagstaff

1970’s-80’s – US Bureau of Reclamation (and partners) perform cloud seeding research across the West US, including AZ (Mogollon Rim Studies)



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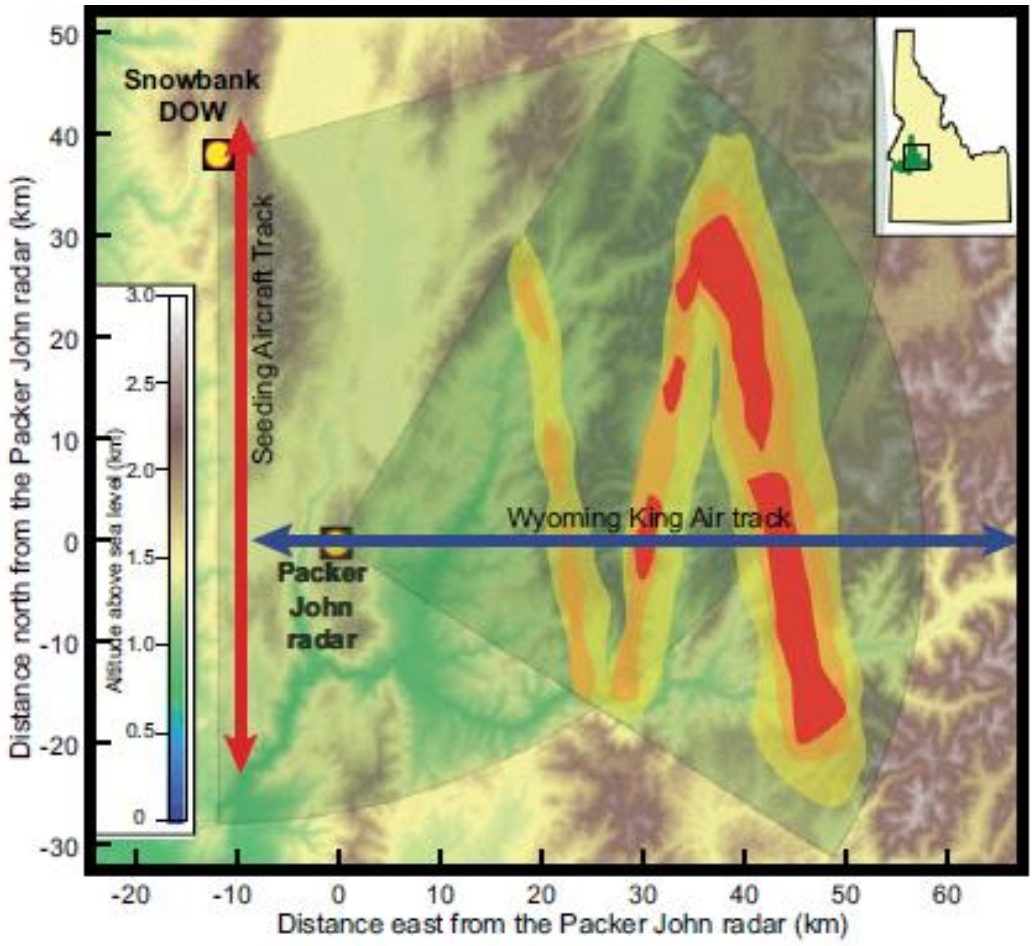
Breakthroughs in Science



Arizona Project (1995)

- Major field project focused on Mingus Mt/Mogollon Rim (Happy Jack, AZ)
- Early use of high-resolution modeling in cloud seeding research (MM5 weather model)

Wyoming Weather Modification Pilot Program (2008-2013)

- Rigorous randomized target/control study
- Statistical results indicate 5-15% increase but not statistically significant
- High-resolution model (WRF) lead to scientific understanding of results

SNOWIE (2017)

- Field project with a lofty goal of documenting lifecycle of cloud seeding process
- SUCCESS!

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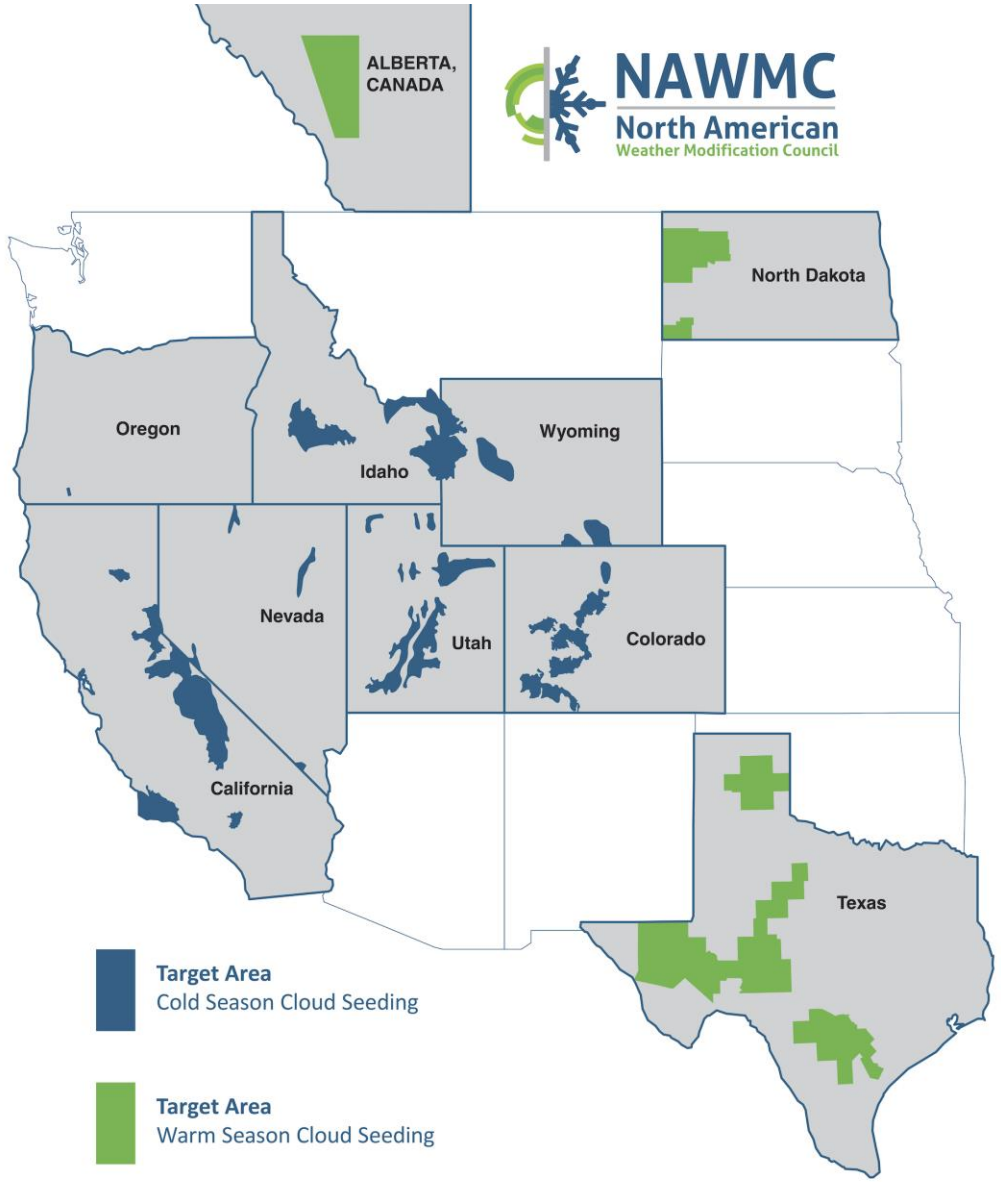
Winter Cloud Seeding Activities in the West

Winter Cloud Seeding Activities in the West



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Winter Cloud Seeding Activities in the West

Winter Cloud Seeding – State Activities			
State	# of Active Projects	Funding Source	Cloud Seeding Operations
California	16	- State? - Local - Private	Since the 1950's
Colorado	6	- State - Local - Private - External States	Since the 1950's
Idaho	3	- State - Local - Private	Since 2003
Nevada	4	-State -Local -Private	Since the 1960's
Utah	7	- State - Local - Private	Since the 1950's
Wyoming	3	- State - Local - Private - External States	Since 2014

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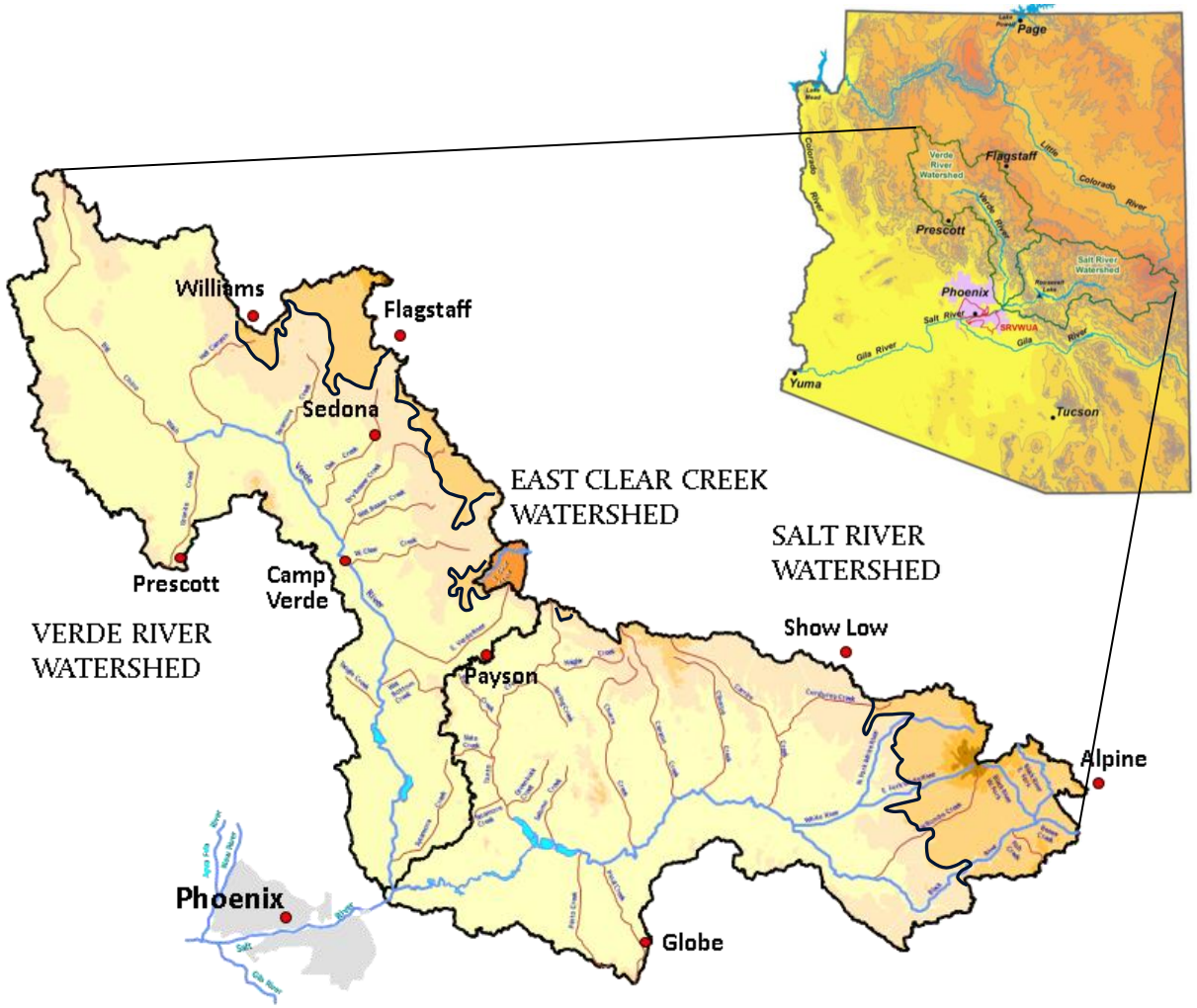
White Mountains Research Project

Salt & Verde Watershed 8,300,000 acres		
	White Mts	Remainder of the Salt & Verde Watershed
Area abv 7500’	492,800 acres	206,720 acres
Area abv 8000’	384,000 acres	33,280 acres
Area abv 9000’	121,600 acres	0 acres



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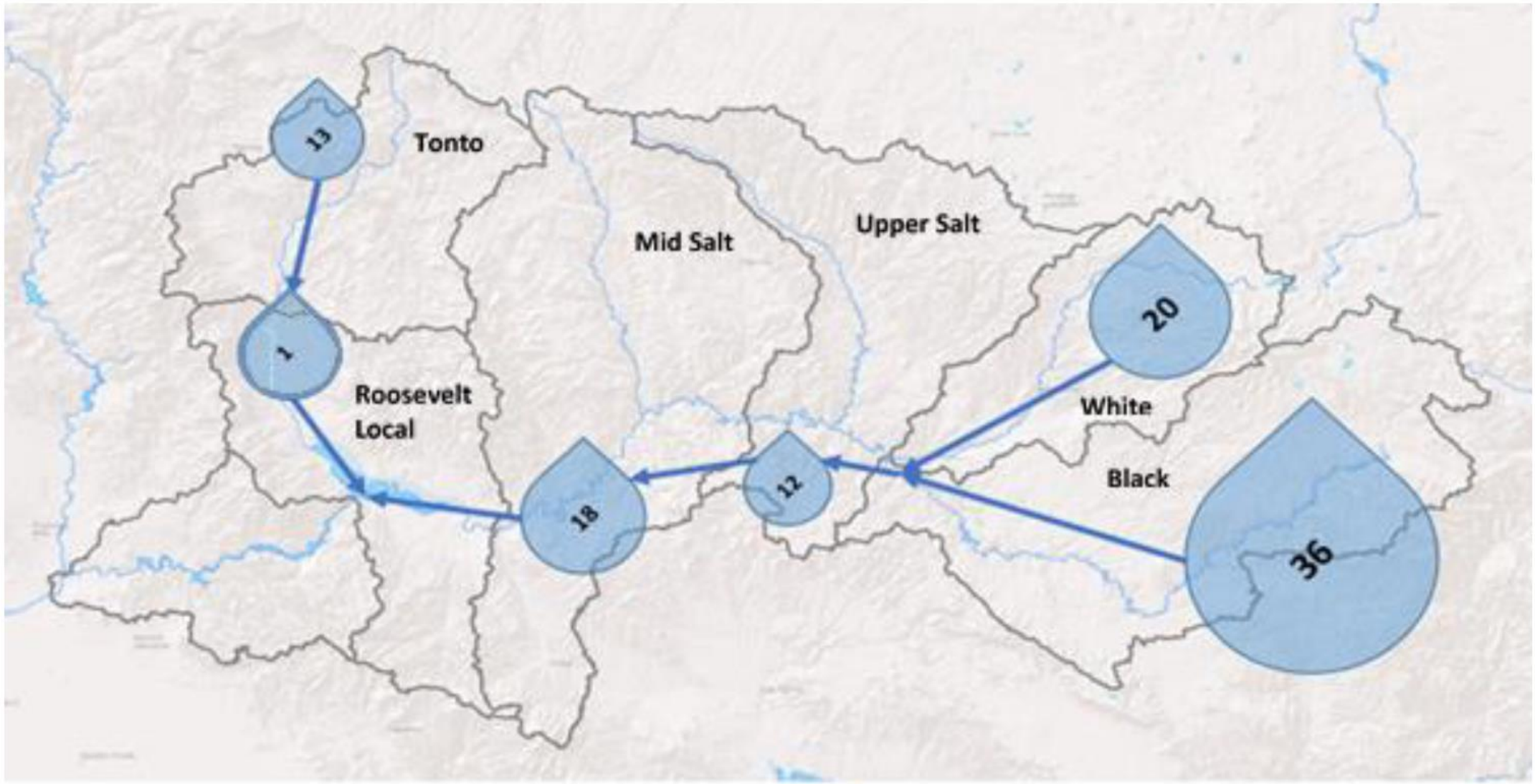
White Mountains Research Project



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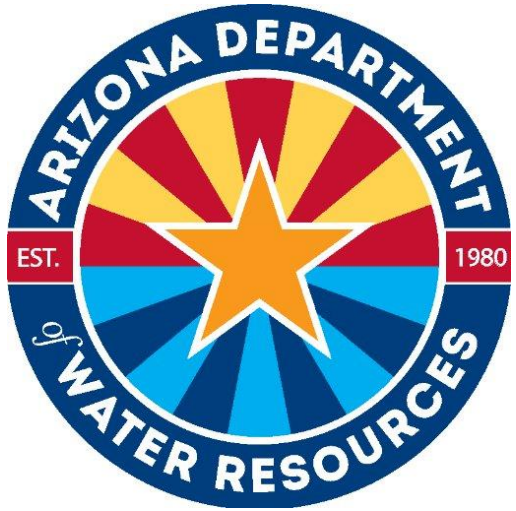
White Mountains Research Project



White Mountains Research Project

Winter Cloud Seeding Climatology

1. Evaluate cloud seeding potential using long-term climate observations and icing algorithm

2. Evaluate cloud seeding potential using a high-resolution numerical weather model

3. Identify potential target area and cloud seeding methodologies from a plume dispersion model

4. Perform cost benefit analysis from results of task 1-3 and a hydrology model

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Questions

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Discussion

Are Committee members interested in pursing this topic further? If so, what are the next steps? (e.g., breakout group, future presentations, etc.)

III. Development of Long-Term Water Augmentation Plan

Wade Noble, Committee Chair

IV. Next Steps

V. Adjournment